

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JUSTIN K. BRASK,
TIMOTHY E. GLASSMAN, MARK L. DOCZY,
and MATTHEW V. METZ

Appeal 2007-4365
Application 10/771,267
Technology Center 2800

Decided: April 29, 2008

Before BRADLEY R. GARRIS, CHARLES F. WARREN, and
PETER F. KRATZ, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner finally rejecting claims 27 through 38 in the Office Action mailed December 20, 2005. Claims 35 through 38 were subsequently canceled in the Amendment filed February 15, 2006 which was entered in the Advisory Action mailed March 3, 2006. 35 U.S.C. §§ 6 and 134(a)(2002); 37 C.F.R. § 41.31(a)(2005).

We affirm the decision of the Primary Examiner.

Claim 27 illustrates Appellants' invention of a method of making a semiconductor device having a high-k gate dielectric layer, and is representative of the claims on appeal:

27. A method of making a semiconductor device, comprising:
- forming a high-k gate dielectric layer on a substrate, the high-k gate dielectric layer comprising impurities and oxygen;
 - exposing the high-k gate dielectric layer to a solution that comprises hydrogen peroxide at a sufficient temperature for a sufficient time to remove impurities from the high-k gate dielectric layer and to increase the oxygen content of the high-k gate dielectric layer;
 - applying sonic energy while the high-k gate dielectric layer is exposed to the solution that comprises hydrogen peroxide; and then
 - forming a gate dielectric on the high-k gate dielectric layer.

The Examiner relies upon the evidence in these references (Ans. 3):

Visokay	US 2003/0045080 A1	Mar. 6, 2003
Ahn	US 2004/0043569 A1	Mar. 4, 2004
Boyd	US 6,845,778 B2	Jan. 25, 2005

Appellants request review of the ground of rejection under 35 U.S.C. § 103(a) advanced on appeal (Br. 8): claims 27 through 31 as unpatentable over Visokay in view of Boyd (Ans. 3); and claims 32 through 34 as unpatentable over Visokay in view of Boyd as applied to claim 27, and further in view of Ahn (Ans. 5).

Appellants argue the first ground of rejection based on representative claim 27. Br. 9. Appellants specifically argue only claim 33 with respect to the second ground of rejection. Br. 11. Thus, we decide this appeal based on claims 27 and 33. 37 C.F.R. § 41.37(c)(1)(vii)(2005).

The issues in this appeal are whether the Examiner has carried the burden of establishing a *prima facie* case of obviousness in each of the grounds of rejection advanced on appeal.

The plain language of independent claim 27 specifies a method of forming a high-k gate dielectric layer which comprises at least forming said layer, wherein the layer, as formed, comprises at least any manner of impurities and oxygen; exposing the layer to a solution comprising at least hydrogen peroxide at sufficient temperature for sufficient time to remove impurities to any extent from and increase the oxygen content in the layer; and applying sonic energy while the layer is exposed to the hydrogen peroxide containing solution. Claim 33 depends on claim 32, the latter claim limiting claim 31 by specifying that the impurities comprise at least at any amount, however small, of chlorine. Thus, claim 33, specifying “the impurities permeate through the high-k gate dielectric layer,” limits the claims on which it depends by requiring that the impurities of the dielectric layer, some of which can be chlorine, permeate through the layer.

We find Visokay would have disclosed to one of ordinary skill in this art a method of forming a thin high-k gate dielectric layer of, among other things, hafnium silicon oxynitride on a substrate. The method includes exposing the layer, by conventional immersion or spraying onto the wafer surface with spray tools, to a solution comprising at least hydrogen peroxide at a temperature and for a time sufficient to increase the oxygen content. The solution can further comprise, among other things, HCl and NH_4OH . The deposition method for the layer can include chemical vapor deposition (CVD) and atomic layer deposition (ALD) without limitation on the method or the precursors. Visokay, e.g., ¶¶ 0003, 0012, 0024, and 0029. The treatment can further remove carbon incorporated as an impurity into the layer from organic precursors during CVD. Visokay, e.g., ¶¶ 0020, 0024, and 0031.

We find Boyd would have disclosed to one of ordinary skill in this art a method of applying cleaning solutions to a wafer surface after fabrication using a megasonic spray tool that provides localized heating and sonic energy to the solution, which increases the effectiveness of the solution. The solutions can be, among other things, mixtures of hydrogen peroxide and HCl or NH_4OH . Boyd, e.g., col. 2, ll. 33-49, col. 3, ll. 1-16, col. 4, ll. 23-37, col. 6, ll. 3-48, col. 8, l. 22 to col. 9, l. 5, and Figs. 2A, 3, and 6.

We find Ahn would have disclosed to one of ordinary skill in this art a method of forming a thin dielectric layer, including gate dielectric layers, of hafnium silicon oxynitride on a substrate by ALD using chlorine containing precursors. Ahn, e.g., ¶¶ 0009, 0025, 0034-0047, and 0056-0077.

We determine the combined teachings of Visokay and Boyd alone and as further combined with Ahn, the scope of which we determined above, provide convincing evidence supporting the Examiner's case that the claimed invention encompassed by claims 27 and 33, as we interpreted these claims above, would have been prima facie obviousness to one of ordinary skill in the semiconductor fabrication arts familiar with forming high-k gate dielectric layers of hafnium silicon oxynitride on a substrate. With respect to claim 27, we agree with the Examiner that this person would have found in Boyd the disclosure of a spray tool device that can apply the same hydrogen peroxide containing solutions taught by Visokay to the surface of a wafer. The spray tool can further provide heat to the solution which is required by Visokay in the application of such solutions to hafnium silicon oxynitride layers, as well as sonic action which would increase the energy of the solutions as applied. Thus, we agree with the Examiner that one of

ordinary skill in the art would have had a reasonable expectation of successfully increasing the oxygen content of the hafnium silicon oxynitride dielectric layer and further removing any incorporated carbon in that layer. We determine this person would have reasonably expected from the teachings of Visokay that the carbon is incorporated throughout the layer, that is, permeate the layer, because it is derived from a precursor used in a CVD process to form the layer.¹

With respect to claim 33, we determine one of ordinary skill in this would have applied a hydrogen peroxide containing solution to a hafnium silicon oxynitride applied by ALD as taught by Visokay and Boyd, which can be prepared with the precursors taught by Ahn, in the reasonable expectation of successfully increasing the oxygen content of the hafnium silicon oxynitride dielectric layer. While Visokay does not disclose the removal of chlorine impurities that would permeate the dielectric layer as imparted by Ahn's ALD precursors, Appellants' finding that such impurities are removed does not patentably distinguish the claimed invention over the applied references. In this respect, it is well settled that the elucidation of the mechanism of an old process or discovery of a new benefit of that process does not render the old process again patentable simply because those practicing the process may not have appreciated the mechanism or the results produced thereby. *See, e.g., In re Spada*, 911 F.2d 705, 707 (Fed. Cir. 1990); *In re Woodruff*, 919 F.2d 1575, 1577 (Fed. Cir. 1990); *W.L.*

¹ It is well settled that a reference stands for all of the specific teachings thereof as well as the inferences one of ordinary skill in this art would have reasonably been expected to draw therefrom, *see In re Fritch*, 972 F.2d 1260, 1264-65 (Fed. Cir. 1992); *In re Preda*, 401 F.2d 825, 826 (CCPA 1968), presuming skill on the part of this person. *In re Sovish*, 769 F.2d 738, 743 (Fed. Cir. 1985).

Gore & Assocs. v. Garlock, Inc., 721 F.2d 1540, 1548 (Fed. Cir. 1983)(“[I]t is . . . irrelevant that those using the invention may not have appreciated the results[,] . . . [otherwise] it would be possible to obtain a patent for an old and unchanged process.” (citations omitted)); *In re Skoner*, 517 F.2d 947, 950 (CCPA 1975).

Accordingly, we are of the opinion that, as the Examiner has established, *prima facie*, one of ordinary skill in this art routinely following the combined teachings of Visokay and Boyd and as further combined with Ahn would have reasonably arrived at the claimed invention, including all the limitations thereof, encompassed by claims 27 and 33 without recourse to Appellants’ Specification. *See, e.g., KSR Int’l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1739 (2007)(a patent claiming a combination of elements known in the prior art is obvious if the improvement is no more than the predictable use of the prior art elements according to their established functions); *In re Kahn*, 441 F.3d 977, 985-88 (Fed. Cir. 2006); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981)(“[T]he test [for obviousness] is what the combined teachings of the references would have suggested to those of ordinary skill in the art.”); *Sovish*, 769 F.2d at 743 (skill is presumed on the part of one of ordinary skill in the art); *In re Bozek*, 416 F.2d 1385, 1390 (CCPA 1969)(“Having established that this knowledge was in the art, the examiner could then properly rely, as put forth by the solicitor, on a conclusion of obviousness ‘from common knowledge and common sense of the person of ordinary skill in the art without any specific hint or suggestion in a particular reference.’”); *see also In re O’Farrell*, 853 F.2d 894, 903-04 (Fed. Cir. 1988)(“For obviousness under § 103, all that is required is a reasonable expectation of success.” (citations omitted)).

Upon reconsideration of the record as a whole in light of Appellants' contentions, we are of the opinion that Appellants have not successfully rebutted the prima facie case. We recognize that the purposes of applying the hydrogen peroxide solutions to the surfaces of layers on a substrate differs between Visokay and Boyd as Appellants contend (Br. 9-10). However, we are of the view that one of ordinary skill in this art would recognize in Boyd's spray tool a suitable means to apply the same solutions to the same or similar surfaces with the application of heat and the energy to achieve Visokay's purposes. Furthermore, the application of hydrogen peroxide solutions using Boyd's spray tool for Visokay's purposes would be recognized by one of ordinary skill in this art to apply to hafnium silicon oxynitride dielectric layers prepared by Ahn's ALD process. Indeed, Visokay discloses that such a process can be used to prepare hafnium silicon oxynitride dielectric layers. While one of ordinary skill in this art may not have recognized the benefit of removing chlorine that permeates the layer, as Appellants contend (Br. 11), this does not patentably distinguish the claimed process over the prior art. In other words, Appellants have done no more than apply hydrogen peroxide solutions using a spray tool to Ahn's hafnium silicon oxynitride dielectric layer as taught by Visokay and Boyd. *See, e.g., In re Kronig*, 539 F.2d 1300, 1304,(CCPA 1976)("[I]t is sufficient here that [the reference] clearly suggests doing what appellants have done.").

Accordingly, based on our consideration of the totality of the record before us, we have weighed the evidence of obviousness found in the combined teachings of Visokay and Boyd and further combined with Ahn with Appellants' countervailing evidence of and argument for nonobviousness and conclude that the claimed invention encompassed by

appealed claims 27 through 38 would have been obvious as a matter of law under 35 U.S.C. § 103(a).

The Primary Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv)(2007).

AFFIRMED

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